THE

Mariners Compaſs

COMPLEATED:

OR, THE

COMPLEMENT of the ART of

NAVIGATION

Diſcover'd and Propos'd.

BEING

A DISSERTATION concerning the *Magnetical Variations* of the Mariners Compaſs, and the *Variation of that ſame Variation*, (according to a new Hypotheſis and Syſtem.)

AS ALSO

DIRECTIONS for the Uſe of an *Univerſal Inſtrument*, Invented for Ready Knowing the Variations of the Mariners Compaſs, *at all Times and Places.*

By Z. Williams

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THE *Art of Navigation* and a *Powerful Fleet*, either for *Trade* or *War*, were ever accounted, and that very juſtly, *Great Britain's* Brazen Walls and Treaſure-Bringers; the Inhabitants thereby (by the Aſſiſtance of Divine Providence) becoming both Rich, Powerful, and Formidable to their Enemies: And therefore any uſeful Improvements therein, does merit a juſt Claim to the beſt Encouragements.

TO

THE KING'S MOST EXCELLENT MAJESTY.

To His Royal Highneſs FREDERICK PRINCE OF WALES.

To His Illuſtrious Highneſs WILLIAM DUKE OF CUMBERLAND.

To His Serene Highneſs WILLIAM PRINCE OF ORANGE.

And every of the ROYAL FAMILY.

This ſhort Treatiſe and its Purport, for the very great Improvement and better Certainty in the Art of *Navigating Ships at Sea*, praying Your Majeſty's Sanction, is moſt humbly Dedicated, By,

Dread Sovereign,

Your moſt Obedient, and Loyal Subject,

ZACHARIAH WILLIAMS

TO

THE KING'S MOST EXCELLENT
MAJESTY.

To His Royal Highness FREDERICK
PRINCE OF WALES.

To His Illustrious Highness WILLIAM
DUKE OF CUMBERLAND.

To His Serene Highness WILLIAM
PRINCE OF ORANGE.

And every of the ROYAL FAMILY.

This Edition Tuscola and its Support, for
the very great Improvement and better
Certainty in the Art of Navigation
and Sea, paying Your Majesty's
Sanction, is most humbly Dedicated,
By,

Your Sovereign,

Your most Obedient, and
Loyal Subject,

TO

The Right Honourable, &c.

The Commiſſioners conſtituted by Parliament for Diſcovering the LONGITUDE at Sea,

AND

For Examining, Trying, and Judging of all Propoſals, Experiments, and Improvements relating to the ſame.

This SPECIMEN of certain Calculations (Intended as an uſeful Improvement in the Art of *Navigation* and *Geography*) is humbly ſubmitted to their Examination and Judgment,

By the Author,

ZACHARIAH WILLIAMS.

To the Honourable

EAST-INDIA Company,

AND OTHER

Mercantile Companies:

The Publication of this Treatiſe, tending to the great Improvement of *Navigation*, is humbly ſubmitted to their Honours Peruſal and wiſe Conſideration;

By

ZACHARIAH WILLIAMS.

TO

The Honourable, Learned, and Ingenious Gentlemen of

The *Royal Society.*

SIRS,

INasmuch as the Body of your Honourable SOCIETY does consist of very Worthy, Eminently Learned and Judicious Members; whose chief Design is to Cultivate Arts and Sciences, to Countenance and Encourage the Indus-

Induſtrious Searchers out and Diſcoverers of profitable Inventions, to Cheriſh the weakeſt Attempts for that End, and thereby to propagate ſolid Learning and true Knowledge, (which are neceſſary Qualifications in a well-govern'd Common-weal.) *Theſe* Virtuous and Noble Deſigns, by Your Indefatigable Induſtry have met with ſuch good Succeſs, and are ſo well known in the World, that they have gain'd You the univerſal Renown and juſt Admiration of all who know how to value ſuch a great Bleſſing to Mankind, eſpecially to this our *Britiſh* Nation.

Theſe

Theſe Your noble Benevolences, Candor, and Generoſity, embolden me (Worthy Sirs) to ſubmit the following *Introductory Specimen* to Your Examination and candid Sentiments: and if found in any degree deſerving, be pleaſed to favour the ſame with Your kind Approbation; thereby Recommending it with Credit to be Introduc'd, and to be Conſider'd by thoſe Powers that will Countenance the ſame, and give ſuch Encouragements as may ſufficiently enable me to proceed to make manifeſt certain uſeful *Magnetical Properties*, as are not hitherto taken Notice of

by the Inquiſitively Curious, and to compleat the whole Work, if it pleaſe God that Life and Health continue, and other Circumſtances concur. I am,

Honourable Gentlemen,

With great Reſpect,

Your very humble Servant,

ZACHARIAH WILLIAMS.

THE PREFACE.

A *Practical Method for knowing the* Magnetical Variation *(for any Time) at diſtant Places, and a* Theory *thereof, has been judg'd by moſt Men equally difficult with that of finding the* Longitude at Sea, *(yea even impoſſible) as having exerciſed the Wits of very many Inquiſitively Learned and Ingenious Men, both in this and former Ages: But that there is ſuch a Method found, this Eſſay will*

manifeſtly declare, as may be ſeen by the large Specimen *of a* General Table *of the* Magnetical Variations *for the preſent Time being. If there be obſerved any Error therein, it may juſtly be attributed to the Imperfect Accounts of the Magnetical Variations in former Times (as having my firſt Data from theſe Accounts) and not to my Theory; and if any Perſon be ſo candid, as to communicate to me a more perfect Account of the preſent* Magnetical Variations, *(than thoſe in the Table) at noted Places, whoſe true Longitudes (from* London) *are already known, I ſhall*

by

by the ſame Theory rectify the whole.

It would be needleſs here to mention the many excellent and advantageous Uſes, a general Knowledge of the Magnetical Variations *would be of to Mankind; with regard to* Navigation, Surveying, Geography, Dialing, Miners, *(or Dealers in* Mines) *&c. ſeeing that neither can be well perform'd without the Knowledge of the aforeſaid* Magnetical Variations.

And further to evince and ſatisfy concerning the true Knowledge of the Magnetical Variation *of the Mariners Compaſs, its important*

portant Uſe in the Art of Navigation, *the Validity thereof, and the great Improvement the ſaid Art may receive thereby, I refer the Reader to a ſmall Tract written by an antient Author, well ſkill'd in the Art of* Navigation, *viz. Mr.* Edward Wright's Haven-finding Art; *to which is added, the Learned* Petrus Plantius's Table of the Magnetical Variations in Antient Times: *But the* Variation of the Variations *had not then been obſerv'd, neither at the Places mention'd in the ſaid Table, nor any where elſe; nor was the ſaid* Variation of the Variations *obſerv'd and known till*

after-

afterwards; neither are the Laws thereof hitherto ſufficiently known and publiſh'd by any; nor has it hitherto been Attempted by any one elſe in this Manner, and according to this Specimen, beſides my ſelf.

If this Eſſay (of mine) be thought well of, and accepted with ſuitable and ſeaſonable Encouragements to proceed, I ſhall then publiſh my Univerſal Table *of the* Magnetick Variations, *in like Form with this* Specimen, *and other uſeful Magnetick Properties neceſſary to be known, not hitherto taken Notice of. All which is ſubmiſſively recommended to be conſi-*

considered by the truly Virtuous, Illustrious, Noble, Honourable, &c. *as also by all Merchants, Mariners, Geographers, and all others who are Lovers and Promoters of useful Arts and Inventions. In the mean while I rest*

Yours,

Z. W.

A

DISSERTATION

Concerning the

MAGNETICAL VARIATION

OF THE

Mariners Compaſs;

AND THE

Variation of that ſame Variation.

According to a new Hypotheſis.

OBſerving the great Imperfection both in *Geography* and *Navigation*, I have with much Diligence apply'd my Thoughts, to ſearch

out the moſt probable Ways and Means whereby to Rectify the ſame. After many ruminating Thoughts, I reſted my ſelf herein ſatisfy'd, that a compleat *Magnetical Syſtem* would beſt anſwer the ſaid Purpoſe.

Therefore, amongſt the many excellently Curious and moſt Profitable Branches of *Philoſophical* or *Mathematical* Learning, the Knowledge of the *Magnetical Variations* (and conſequently the *Longitude-Diſtance* of any two Meridians) is generally allow'd and acknowledg'd (by the *Geographers* and *Mariners* of theſe later Ages) to be exceeding uſeful and neceſſary, both in *Geography* and in the Art of *Navigation*; and conſequently very advan-

advantageous to the Induſtrious *Merchants*, (and likewiſe to all the Trading World) both for facilitating of Voyages on Sea, and alſo for the aſcertaining of *Geography*; the which is generally allow'd to be very Imperfect in many Parts of the known World.

The Conſideration whereof, has inclined ſeveral Learned and Ingenious Men in this later Age, moſt Induſtriouſly (tho' without Succeſs) to ſearch out Ways and Means for obtaining the ſame by various *Inventions*; eſteeming it a Glory to that People and Nation who (happily) ſhould be the firſt Diſcoverers thereof.

However, all the Methods and Inventions hitherto by them made uſe of, being not ſuffici-

ently Probable for obtaining the fame, yet deſervedly to be praiſed for their Induſtrious Endeavours.

Theſe Learned and Inquiſitive Perſons, * Antient and Modern, that have written concerning the hidden Properties of the *Loadſtone*, and its Uſe in *Navigation*; being not ſufficiently acquainted with the unerring *Magnetick Laws* of the whole Univerſe, and conſequently of the ſudden Changes of the *Variations*, and of the continual Variating of that ſame

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* *Viz.* EPICURUS, GALEN, THALES, SCALIGER, LUCRETIUS, MILESIUS, GRANDAMICUS, GILBERT, CABEUS, NORMAN, BURROWS, KIRCHER, RIDLEY, DIGBY, BOYLE, CHARLETON, GASSENDUS, DES-CARTES, BESTARDUS-GALLUS, ROHAULT, BARLOW, *&c.*

Varia-

Variation; on the true Knowledge of which chiefly depend the aforeſaid Diſcovery: * For neither Time-keepers, (how curious ſoever) with the Ship's Way, or Courſe and Diſtance † Run, (the which is the beſt Method

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* Time-keepers, whether Clocks or Watches, Springs, Pendulums, Glaſſes with Sands or Fluids, Natural or Artificial, of what Contrivance or Invention ſoever, and ever ſo carefully and artfully made, will not meaſure Time ſufficiently exact for this Purpoſe; by reaſon of the complicate Effects that the *Univerſal Magnetiſm* and Gravitation, the different Degrees or Temperatures of Heats and Colds, Drineſs and Moiſture, have on all kinds of Pendulums, Springs, Wheelworks, *&c.* and the different Degrees of theſe Effects in different Parallels and Meridians, *&c.*

† The Menſuration of the Way or Runs of a Ship at Sea, cannot be exactly known, either by the Log-Line, Mare-Meeter, nor any other Contrivance whatſoever; by reaſon of the complicate Motions, and other Accidents that uſually happen at Sea; as Currents, Counter-currents, a Ship's Trim, unſteady Winds, *&c.*

hitherto

hitherto known and practis'd;) nor * any Celeſtial Obſervation whatſoever, whether of the Eclipſes of the Luminaries, *i. e.* of the *Sun* and *Moon*, nor thoſe of the Satellites of *Saturn* or *Jupiter*; nor yet the different Times of the *Moon*'s coming to the

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* Proper Inſtruments for Celeſtial Obſervations are not eaſily procur'd; and there are but very few that are capable to make a right Uſe of them, and be at the Trouble of the tedious Calculations belonging thereto, even by Land, and by Sea much fewer: Good Obſervations being very difficult, and fair Opportunities for ſuch Obſervations ſeldom happen. If ſo that by help of good Time-keepers, and accurate Celeſtial Obſervations, the true Knowledge of the *Meridian* of a Place be obtained; yet if at the ſame time the true Knowledge of the then *Magnetical Variation* and *Latitude* at that ſame Place be not known, the Ship-Maſter may (notwithſtanding his utmoſt Care and Skill) ſteer much wide of his intended Courſe; and thereby may miſs of arriving opportunely at his deſign'd (or deſired) Port.

South,

South, nor its Appulſes to any of the Fixed Stars, nor any other Celeſtial Obſervation; nor * yet the Mariners chiefeſt Guide (hitherto known) *i. e.* the Knowledge of the *Latitude* and the *Sea Compaſs*, together with the Menſuration of the *Ship's Way*, (as hitherto practiſed) I ſay, neither of theſe are ſufficient to anſwer that degree of Exactneſs proper for obtaining the *Longitude* on Sea, (a very conſiderable Article in *Navigation)* and chiefly depending on a circumſtantial Knowledge of the *Magnetick Laws*.

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* For on what *Courſes* ſoever a Ship ſails, the *Magnetical Variation* will continually alter on all *Parallels* and *Meridians*, except on the Courſe of *Equal Variations*, which will delineate or form a kind of a Curve, ſuitable to that ſame Courſe.

Not

Not finding any thing ſatisfactory to me publiſh'd, neither by Antient nor modern Authors, concerning that *Neſt of Wonders*, i. e. the *Loadſtone*, and ſuppoſing it no Crime to deliver my modeſt Thoughts concerning the ſame, (not impoſing it on any as an Article of Faith) I have Eſſay'd (or Attempted) a *Magnetick Theory*; the which I have digeſted or methodiz'd into a certain *Treatiſe*, (if the Publication thereof be ſeaſonably encourag'd by proper Powers) it being *A compleat Magnetical Syſtem*, containing a moſt plain and eaſy Method, with all neceſſary *Rules* and *Tables* for practical Application: The which, together with the right Uſe of certain Inſtruments

ments well made, (the Invention and Contrivance of which I have deduced from *Magnetical Principles*) either the *Longitude* Diſtance of any two Places, as I humbly preſume, or the *Magnetical Variations* at the ſaid Places for any Time given, may be known either on *Sea* or *Land*; and that much more exact than by any other Method hitherto known and practis'd.

From a due Conſideration of what I have already mention'd, it may very reaſonably be allow'd (and daily Experience does in ſome degree teſtify) that the true Knowledge of the *Magnetical Variations* at *any Time* and *Place*, is of ſuch Importance in the Art of *Navigation*, that without the

Knowledge thereof, no Ship-Maſter (how able ſoever elſe) may (without much Hazard) venture to launch out into the pathleſs and wide Ocean; eſpecially if we conſider how that the *Magnetical Variations* do in many Parts of the World, conſiderably alter in a very little Diſtance, as alſo the continual *Variating* of that ſame *Variation* in the ſelf-ſame Place, either by increaſing or decreaſing Eaſtwardly or Weſtwardly: So that the Knowledge of the then *Magnetical Variation* on any Parallel and Meridian, may very reaſonably be granted to be a very conſiderable Aſſiſtance to the careful and skilful *Mariner*, for correcting his Reckoning, being confus'd

before

before by Streſs of Weather, &c. and thereby ſave Himſelf from the Perplexity of the Toil and Labour of Tacking to and fro; beating the Sea for a long time, before he can eſtimate whereabouts he is; and the *Voyage* prolonged, to the no ſmall Charge of the Maſter, Merchants, and Owners, if not the Endangering of the whole; as being not able to arrive in due time at the deſired Haven. For by knowing the preſent *Magnetical Variation* at any Parallel and Meridian, the skilful Mariner by his careful and accurate Obſervations, both of the *Latitude* and of the then *Magnetical Variation*, (made with good Inſtruments, and at fit Opportunities) may know

when he does approach to ſuch a Meridian, (or Point of Interſection) notwithſtanding his being before toſt to and fro for ſome time by various and ſtormy Winds, and his *Traverſe* and *Reckoning* confus'd and uncertain.

I humbly preſume that what is here ſaid concerning the *Variation*, will be allow'd to be Reaſonable by every unprejudic'd and skilful Mariner, (and others Mathematically Learned:) The which if granted, (as juſtly it may) it then may reaſonably be concluded, That by an Univerſal *Scheme* of the *Magnetical Variations*, and curiouſly good *Obſervations*, both *Geography* (if induſtriouſly endeavour'd after) may

may more truly be aſcertain'd and ſettled, and the Art of *Navigation* highly improv'd.

And as a general *Specimen* of the ſaid Performance, I have calculated a *Table* of the *Magnetical Variations*; in which Table (by Inſpection only) may be obtain'd the *Magnetical Variations* that may be found by accurate Obſervations, (theſe few enſuing Years, commencing *A.D.* 1741.) at the Interſections of every five Degrees both of Latitudes and Longitudes, in both the Northern and Southern Hemiſpheres: The *Latitudes* continued from the common Equator to 70 Degrees of both Northern and Southern Latitudes: The *Longitudes* being accounted both Eaſtwardly and Weſt-

Weſtwardly from the firſt Meridian in the Table, as may be obſerved in the *Specimen* of the ſaid Table; the which Specimen extends from 20 Deg. to 70 Deg. North Latitudes, and from 35 Deg. Eaſt, to 40 Deg. Weſt Longitudes from the Meridian of *London*.

If any ſhould object, That the *Variations*, as they are found by my Tables, do in ſome Places ſomewhat differ from the Obſervations ſet down in ſeveral *Journals* and *Voyages* of able *Maſters* and *Mariners*; and conſequently, the Diſtance of Continents muſt differ from what they are ſet down in Maps, Sea Charts, &c.

To which may be anſwer'd, That it is generally allow'd that *Geo-*

Geography is very Imperfect, and the *Courſe* and *Diſtance Run* being very Uncertain, by reaſon of Currents, Trade-Winds, and the defective Methods (made uſe of) for the Menſuration of Time and the Ship's Way; together with ſudden Changes of the Angles of Variations in many Places, eſpecially near the Northern and Southern Coaſts: to which may ſometimes be added, the Badneſs of *Inſtruments*, (eſpecially the *Magnetick Needles*, of which few or none have hitherto been made and proportioned ſuitable to the Laws of Magnetick Principles;) careleſs *Obſervations*, and other Accidents, as the being too near Iron, or Iron Mines, Gulphs and Promontories, &c.

And

And therefore, no marvel if the *Variations* as found by my *Tables*, ſhould ſomewhat differ in ſome Places from others Obſervations, it being probable that the Place of theſe Obſervations were either nearer to, or farther off than the ſuppos'd Meridian; and may juſtly be ſuſpected not to be the true Meridian of the ſaid Place. The *Variations* as found by the ſaid *Tables*, being deduced from the unerring Laws of *Magnetick Principles*; and therefore may be of good Uſe for the more certain Knowledge of the true Meridian of any Place, whether on Sea or Land: The Truth hereof may beſt be try'd and verify'd by careful Obſervations made on Land, both of the

Eclipſes

Eclipſes and alſo the *Magnetical Variations.*

And in order to the better obtaining the true Knowledge of the *Magnetick Laws* of *Variation*, it is greatly to be wiſh'd that thoſe *Royal* and *Mercantile* Powers would be ſo Generous for the Publick Good, (*viz.* the greater Safety of Ships, and Mens Lives, and the better ſettling of *Geography*, and accelerating of Voyages by Sea) as to cauſe and encourage *good Obſervations* to be made of the *Magnetical Variations* at noted Places, *viz.* Capes, Head-lands, Iſlands, Sea-Ports, &c. ſpecifying the Times and Place of Obſervation.

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If this ſhort *Specimen* of my Method and Eſſay towards the better ſettling of *Geography*, and the Improvement of the Art of *Navigation*, find favourable Acceptance, I will (God willing) proceed to compleat and publiſh my *Magnetical Treatiſe*; in which is contain'd a moſt plain and eaſy Method, whereby the *Magnetical Variations* for any Time given, may be known at any diſtant Place required, (the Latitude of the ſaid Place being firſt known) as if there preſent accurately obſerving the ſame; otherwiſe, by accurately obſerving the *Latitude* and the *Magnetical Variations* at any Place, the *Longitude* Diſtance of that ſame Place from any other Place (where

(where the then *Magnetical Variations* and the *Latitude* is moſt certainly known) may be exactly known, even to a Nicety.

Moreover, I have Invented and Contrived certain *Inſtruments*, either for Celeſtial or for Magnetical Obſervations, much excelling (if well made) any Inſtruments that are now commonly made and us'd; being much more ready and eaſy for Application, and not ſo ſubject to be diſordered, or to be diſturbed by ordinary Motion, when apply'd for Obſervation.

By the right Uſe of which Inſtruments, either the *Magnetical Variations*, and conſequently the *Longitude* Diſtance of any two Places, may be obtain'd as well

by Night as by Day, the *Latitudes* of both Places being firſt given.

The aforemention'd entirely new *Magnetical Syſtem*, general *Table* of the *Magnetical Variations*, and *Inſtruments*, (which are entirely in my own Power, and hitherto not made known to any) I purpos'd to have Publiſh'd in this our BRITISH NATION; if thoſe *Honourable Perſons*, who by Virtue of their Conſtitutions are impowered to Examine, Try, Countenance, and Cheriſh ſuch Purpoſes, (and to whom I humbly addreſs) would vouchſafe to countenance the ſame, and to grant me a reaſonable and ſuitable Encouragement, ſufficiently enabling me to proceed

ceed to compleat the whole Work; and thereby preſerve to this Nation the *Fame* and *Advantage* of ſo laudable a Deſign, and wherein the Weal and Improvement of the Art of *Navigation* is ſo nearly concern'd.

Howbeit, out of real Inclination to oblige ſuch as are deſirous to be ſatisfy'd concerning the Truth of my *Magnetical Syſtem*, I publiſh this *Table* as a particular *Specimen*, adapted to the nearer, and (to us) better known Parts of the World; the *Latitudes* and *Longitudes* of noted Places being better known to us, and probably nearer the Truth, than Places in remote Parts of the World; by reaſon of the Imperfection of Geography,

phy, and bad Obſervations; and (as I humbly preſume) may juſtly ſuſpect certain Continents to be placed in Maps and Sea Charts no leſs than thirty Degrees, or more, out of their true and proper Meridians; yea, more than fifty Degrees: So widely different and uncertain are both the *Maritime* and *Geographical* Accounts of the Diſtances of Places; as appears at the End of *Wells*'s *Geography*, and ſeveral others.

Let ſuch as are deſirous to be ſatisfy'd concerning the Truth of my *Syſtem*, procure to themſelves from Correſpondents a true Account of the moſt accurate *Magnetical Obſervations*, that has lately been, or that ſhortly may be made,

made, at Places within the Limits of this *Table*, and compare ſeveral ſuch Obſervations with the Table; and thus they may ſoon ſatisfy their Curioſity concerning the Validity and Truth of the ſaid *Table*, and conſequently of my whole *Syſtem*; for as Obſervations accurately made do with this ſame Table agree, ſo will the Agreement of remote Obſervations and the Univerſal Tables be.

The Obſervations ought to be made with very good Inſtruments, at proper Places, and at fit Opportunities.

As for this *Publication*, I equally expect the keen Cenſures of the Proud and Invidious, as I do the candid Sentiments of the truly

truly Virtuous: for all new Diſcoveries have ever had their Favourers and Deſpiſers; by the Majority of the latter, many Things advantageouſly uſeful have been baniſh'd to ſome other Clime, or otherwiſe irrecoverably loſt. However, my real Regard for the Good of this Nation, and my own private Satisfaction does readily diſpoſe me heartily to wiſh, that not only theſe my Endeavours, but all other Inventions and Diſcoveries the which might tend to GREAT BRITAIN's *Renown*, may neither be buried in Oblivion, or otherwiſe tranſmitted to, and promoted by another Nation, (to their laſting Fame and Advantage) but may find favourable Recep-

Reception and ſuitable Encouragement from the truly Noble, Virtuous, and Ingenious Encouragers of uſeful Arts and Inventions; ſo that all the *Chriſtian Trading World* may partake of the ineſtimable Advantage thereof; but more eſpecially this our *Britiſh* Nation, in which this ſo univerſally uſeful a Diſcovery ſhould firſt appear on the Stage of this World *.

It is more than probable, that there are certain predeterminate and appointed Times, for the very firſt Appearance and Effect-

* If not unhappily fruſtrated by the Invidious and Perverſe Diſpoſitions of ſuch as would contemn and obſcure all others Deſigns, (how uſeful ſoever) ſo they may but promote their own chimerical Notions, how inſignificant ſoever.

ing of all and every conſiderably great and uſeful Diſcovery, that ever hitherto have been, or that hereafter may be Invented, Diſcovered, and Produc'd on the Stage of this World, for the great Good, neceſſary Uſefulneſs, and Conveniency of Mankind.

It would be more than an Herculean Task, even only to mention thoſe numerous and very uſeful Inventions and Diſcoveries, that in their pre-appointed proper Times, were Diſcover'd, Contriv'd, and Improv'd, and handed down to theſe Times, for the Conveniency of human Life; as the firſt Diſcovery, and Invention how the various *Minerals* were to be *ſmelted*, and brought to a metaline Form for

Uſe.

Uſe. And thence were invented, contriv'd, and form'd various and ſundry Implements and Utenſils, for divers Purpoſes, neceſſary Uſes and Conveniences; particularly *Iron*: for by its uſeful Help, *Agriculture*, *Architecture*, *Navigation*, and all other uſeful Imployments of Life, were contriv'd, carry'd on, and improv'd from time to time, even to this preſent; as alſo thoſe great and remarkable Diſcoveries and Inventions of later Date; namely, the firſt Invention of *Gun-powder*, *Printing*, and alſo the *Mariners Compaſs*, with its *Verſorial Index* (or *Magnetick Needle*:) The ſaid Compaſs is at this Time very much Improved by ſundry good

Contrivances, &c. yet a conſiderable Branch of its Uſefulneſs remains hitherto undiſcover'd and unknown to the World; namely, the *Laws* of the *Magnetick Variations* of the Magnetical Needle, and the continual *Variating of thoſe Variations*, at all Places on this terraqueous Globe.

For a true Knowledge of the *Variation* of the Magnetical Needle, and *Variating* of that ſame *Variation* at any Time and Place propos'd, and the great Uſefulneſs thereof, is well known, and acknowledg'd by the ableſt Mariners: tho' ſome may moſt ignorantly object, that the Knowledge of *Magnetical Variation* is of very little or no moment, neither in the Art of *Navigation*,

nor

nor any other, &c. If ſo, where-fore ſhould the ſeveral Learned and inquiſitively Ingenious, both in this and the former Ages, be at ſo much Trouble, and Expence both of Time and Money, in their diligent Search after the ſame? as may be obſerved by the indefatigable and induſtrious Endeavours of the Illuſtrious Prince MAURICE of *Naſſau*, chief Admiral of the *Hollanders*, *A. D.* 1596. PETRUS PLANTIUS, Mr. EDWARD WRIGHT, and ſeveral others, both of this and other Nations; and ſince their Time by ſeveral others, very Learned and Ingenious Men, and that too by ſundry and various Inventions, and very coſtly Contrivances; yet neither of 'em, hitherto, poſi-

poſitively preſuming any further than a bare *Suppoſition*, concerning the Cauſe and Laws of the *Magnetick Variations*, and the *Variating* of thoſe *Variations*, at all Places on this terraqueous Globe: nevertheleſs, their Names and Labours are moſt deſervedly and juſtly to be praiſed, for their indefatigable Induſtry and Endeavours in the Purſuit thereof.

For a further Aſſertion of what is already ſaid, I ſhall here preſume to ſubjoin what an able, well-skill'd, and experienc'd *Mariner* and *Mathematician* hath ſome time ſince ſaid, concerning the *Magnetical Variations* of the Mariners Compaſs, *viz.* Mr. Edward Harrison, Lt. in his *Idea Longitudinis*, printed *A.D.* 1696.

and

and by him Dedicated to the Right Honourable the *Commiſſioners* for executing the Office of *Lord High Admiral of* England, &c.

In Chapter V. concerning the *Variation*, he thus proceeds; "The *Variation of the Compaſs* "(by which I mean, the Deflec- "tion of the Needle from the "true Meridian) is of that great "Concernment in the Art of "*Navigation*, that the Neglect "thereof does little leſs than ren- "der uſeleſs, one of the Nobleſt "Inventions Mankind ever at- "tain'd to: I deſire the Ingeni- "ous *Seaman*, that the Know- "ledge of *Magnetick Variation* "may be always in his great "Eſteem; for without it *Navi-*

"*gation*

" *gation* cannot be perfect. It
" is my Opinion, that many
" Ships have been put by their
" deſigned Ports, and more Ships
" loſt for want of knowing the
" *Variation*, than hath been loſt
" for want of the *Longitude*----
" *England* does not know how
" many Loſſes hath hapned for
" want of a better Knowledge in
" the *Variation* of the Compaſs,
" thro' only a Pilot of a Ship---
" If he underſtands not the *Va-*
" *riation*, he may, in my Opi-
" nion, as well deſerve a Rope as
" a Branch---- I have belong'd
" this War to Six ſeveral *Rates*
" in the *Navy*, and never ſaw an
" Azimuth Compaſs aboard any
" of them: My Judgment tells
" me, that every Ship of *War*
" requires

" requires at leaſt three ſuch
" like Inſtruments, to obſerve
" the *Variation*, tho' they ride
" only at Anchor at the *Nore*,
" or in the *Downs*---- Captain
" Wm. Wilbey underſtood the
" *Variation* vrey well, in my
" Opinion; I believe it was as
" good to him as the *Longitude*
" between St. *Helena* and any
" Part of the *Eaſt-Indies* ---
" If the *Variation of the Com-*
" *paſs* were better known, and
" *Tables* of the *Variation* for all
" the moſt noted Parts in the
" World, as Head-lands, Capes,
" Iſlands, &c. the Tables cal-
" culated to a certain Year,
" becauſe of the Increaſe and
" Decreaſe of the *Variation*, and
" the Difference of the *Varia-*

" *tion* between thoſe Places;
" then the Knowledge thereof,
" would be almoſt as good as
" the *Longitude* known.

HAVING premiſed thus much concerning the *Magnetical Variation* of the Mariners Compaſs, and of its Uſefulneſs in the Art of *Navigation*, &c. whatever ſome may ſuggeſt to the contrary, as that a Theory and Knowledge of the *Magnetical Variations* is of little or no moment, neither in the ſaid Art nor any other. If ſo, wherefore (as before obſerv'd) ſhould the Learned and Ingenious, both in this and the former Ages, be at ſo much Expence of Time and Money, in their diligent Search

after the ſame? But it has been juſtly ſuppos'd, that the Art of *Navigation* cannot be compleat without a Theory and Knowledge of the aforeſaid *Magnetical Variations*. And according to the *better Judgments*, or Remarks of the Wiſe, the Art of *Navigation*, and a powerful *Fleet* either for *Trade* or *War*, were ever accounted, and that very juſtly, *Great Britain*'s Brazen Walls and Treaſure-Bringers: The Inhabitants thereby (by the Aſſiſtance of the Divine Providence) becoming both Rich, Powerful, and Formidable to their Enemies; And therefore, any uſeful Improvements therein, do merit a juſt Claim to the beſt Encouragements.

For to anſwer the aforeſaid Purpoſe, *i. e.* the *Magnetical Variations* of the Mariners Compaſs, there is lately Invented, Contriv'd and Compleated, ready for Application, an *Inſtrument*, for obtaining the *Magnetical Variation* at *any Place and Time* requir'd, either *by Day* or *by Night*, whether *near* or at any *remote Diſtance*, on *Sea* or *Land*—and that without any other *Celeſtial Obſervation*, ſave only knowing the *Latitude* of the Place is requir'd.

The which *Inſtrument* is moſt humbly ſubmitted to the Judgment of thoſe proper Powers conſtituted by *Parliament*, for Examining, Judging, and Encouraging of *all* uſeful *Inven-*

tions and *Improvements* relating to *Navigation* and *Geography*.

Concerning the Uſe, *and* Application *of the* INSTRUMENT *for Practice.*

FIRST, Obſerve that each of the Plates are divided into 360 Deg. *i. e.* 180 Deg. Eaſt, and 180 Deg. Weſt; which are the *Meridians* or *Longitudes* Eaſt and Weſt, accounted from the Meridian of *London*, which is the firſt, or common Meridian.

Se-

Secondly, Obſerve that when you intend to apply the Inſtrument to Practice, you are to *Rectify* it, *i. e.* to ſet it to the *Time* and *Place* requir'd; *i. e.* apply the *Magnetical Indexes* to the Degree of the *Magnetick Longitude* for the *Year* propos'd: then turn both the Plates about, until the Degrees which are anſwerable to the *Longitude* of the ſaid Place (whether Eaſtwardly or Weſtwardly) do coincide (or meet) at the common Meridian, *i. e.* the central Line, which directs over the Centers of both the Plates.

Thirdly, Obſerve to ſet off (or draw) a *Magnetick* Meridian Line according to the then Direction of a good Magnetick Needle,

at

at the Place of Obſervation; then place or ſet the whole Inſtrument (or Box) exactly parallel with the ſaid Magnetick Meridian Line: Then place on the Face of the Inſtrument the ſquare Compaſs Box belonging thereto, with a good Magnetick Needle therein; and place the ſaid Box ſo as that the central Line (or middle thereof) may exactly coincide (or meet) with the Parallel of the *Latitude* of that ſame Place that you deſign or require the Obſervation for; (the Parallels of *Latitude* are

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N. B. When you uſe this Inſtrument to obſerve by, be cautious and look well that no Iron be too near, and ſo cauſe an Error in the Obſervation.

the

the Diviſions on the Sides of the Inſtrument) and the Magnetick Needle in the ſaid Box will point out the then *Magnetick Variation* at that ſame Place requir'd.

As for the Deſcription and Contrivance, the Improvements and Amendments of the *Inſtrument*, and the more particular Direction for its Application to Practice at *Sea*, in order to know rightly (at once) both the *Magnetical* and the *Solar Meridians*, as alſo the *Magnetical Variation* of the Mariners Compaſs, and that either by Day or by Night, tho' the Skies were overcaſt and cloudy; I ſhall defer the ſame, in Expectation of an Honourable, Reaſonable,

and

and Sufficient Supply, as an Encouragement to proceed; if what I here propoſe be opportunely thought well of, the Term of my Life being well nigh ſpent.

Vita brevis, Ars longa, Tempus preceps, &c.

A

TABLE

OF THE

Magnetical Variations

At every five Degrees of Parallel and Meridian Interſections, from 35 Degrees Eaſt to 40 Degrees Weſt *Longitudes* from the Meridian of *London*; and from 20 to 70 Degrees North *Latitudes*: ſerving for a few enſuing Years, commencing *A.D.* 1741.

N.B. That when after any Figure you do find a Daſh downwards, thus , it ſignifies *leſs*, and

when upwards, thus ′ *more* than half a Degree of Variation signified by that Number.
E. g. 10′ somewhat more than 10 Deg. and 10, somewhat less than 10 Deg.

Longitudes.	Degrees of Northern Latitudes.										
	20	25	30	35	40	45	50	55	60	65	70
	Magnetical Variations North Westerly.										
Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
35	8′	8′	9,	9,	9	9	9′	10,	10	11′	12
30	8,	8′	8′	9	10	10′	12,	13	14	15′	17
25	9	9	10	10′	12	13′	14,	14′	15′	17,	18
20	10′	11	12	13,	13′	14	15	16	17′	19	20
15	11	11′	12′	13,	13′	15,	16.	17′	19	20′	22
10	12,	12′	13	14	15	16	17′	19	20	22′	25
5	12	13	14	15	16	17′	17′	20	22	24	26
0	12′	13,	14,	15,	16,	17,	17′	20	22	24	27′
5	12	13′	15,	15	17,	18	18′	22	24	26	30,
10	12	14	15	17,	18	19′	21	23	25	28	31
15	12′	14′	15′	16′	18′	20	21′	24	26′	28′	33
20	14,	15	16	17	19	21	23′	25,	27	30′	35,
25	14	15′	17,	18	20	22	24,	26	28	32	35′
30	14′	15′	16′	18′	20	22	24′	27	29′	33′	37′
35	14′	16	17′	19,	20′	23′	25	28	31	34	36′
40	14′	16	17	19	21′	23′	25′	28	31′	36	40′

West Longitudes from London. | Longitudes East from London.

The TABLE *of* Magnetical Variation *explain'd.*

AT the Head of the Table are the *Latitudes*, from 20 to 70 Degrees North Latitudes; and the firſt Column on the left Hand contains the *Longitudes*, Eaſt and Weſt, from the Meridian of *London* --- In the common Angles of meeting are the *Magnetical Variations.*

E. gr. --- Admit that in the Latitude 40 Deg. North, and at the Longitude 20 Deg. Eaſt of *London*, you deſire to know the *Variation* --- Under the Latitude 40 Deg. and againſt the Lon-

Longitude 20 Deg. you will find 13′ *i. e.* thirteen Degrees and ſomewhat more, the *Variation* at the ſaid Place.

Examp. II. If in the Latitude 55 Deg. and Longitude 20 Deg. Weſt from the Meridian of *London*, the *Magnetical Variation* be required --- Under the Latitude 55 Deg. and againſt the Longitude 20 Deg. Weſt, will be found in the common Angle 25, *i. e.* ſomewhat leſs than twenty five Degrees, yet ſomewhat more than twenty four Degrees and half Variation North Weſterly at the ſaid Place, *&c.*

If in this Table there ſhould appear any ſeeming Errors (as poſſibly

poſſibly there may) the ſame may very juſtly be attributed to the various and very uncertain Accounts of the *Magnetical Variations* (given at different Times by ſundry Perſons) and not to the *Theory* whence the Table was calculated; ſeeing that by the ſame Theory the whole may hereafter be Rectify'd, if honourably and ſeaſonably Encouraged.

FINIS.

MVSEVM
BRITAN
NICVM